INTERIM REPORT ON FROSTHEAVE UNDER PAVEMENTS

by

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Introduction

The object of this investigation is to determine the optimum design of highway foundations in Connecticut.

Most soils used as pavement foundations in Connecticut have adequate strength if kept dry, hence this investigation has concentrated on sources of excess moisture in the foundation soils (surface water, groundwater, and frost) and means of reducing or controlling them.

The investigation is being carried out in three phases:

1. Field study of pavements and pavement foundations
2. Laboratory and field study of drainage and drainage methods
3. Laboratory study of frost susceptable soils

This Interim Report summarizes the field studies to date and presents some tentative conclusions. Work on phase 2 and 3 will be reported separately.

The work was carried on with the assistance of T. F. Zimmie and D. Bradshaw, students at the University of Connecticut, under the sponsorship of The Joint Highway Research Advisory Council of Connecticut.

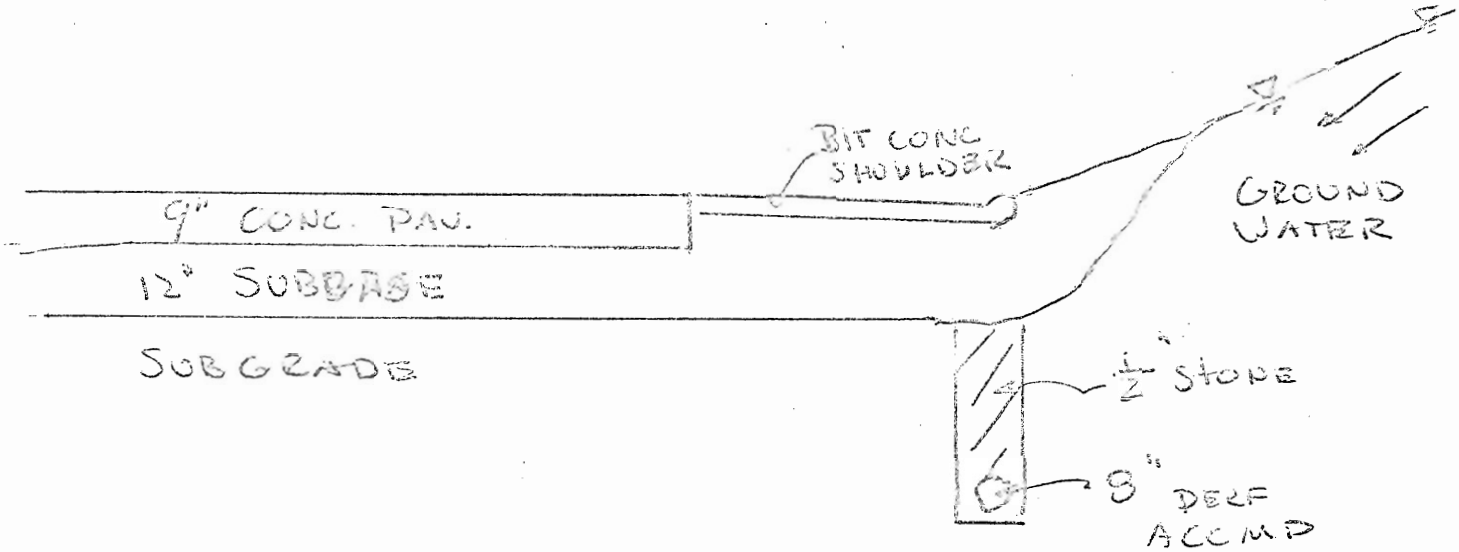
Field Study

In 1968 six sections of highway in Central Connecticut were studied year round. The studies involved:

1. Digging test pits to determine the thickness of the pavement and subbase and to obtain samples for laboratory tests
2. Observation of the condition of the pavement during all seasons
3. Observation of the topography and hydrology of the area, particularly the surface and subsurface drainage facilities

The results of the field studies and laboratory tests are presented and tentative conclusions drawn for each section of highway.

Case A. Rt. 15 East Bound Sunset Hill E. Htfd.



Concrete pavement	-	poor concrete, asphalt overlay
Subbase	-	dirty gravel, nonfrost susceptable, permeability = 10^{-4} ft/min
Subgrade	-	clayey silt, permeability = 10^{-7} ft/min
Underdrain	-	ineffective, ½" stone, clogged on perifery

Observations

1. Concrete pavement is cracked, joints open.
2. Adjacent slope is saturated in spring. Water runs laterally under shoulder into subbase beneath pavement. Subbase is saturated in the spring.
3. Water runs longitudinally in subbase and flows out of lateral joints downhill to west.
4. There are no signs of frost heaving during cold weather.

Apparent Cause of Problem

1. Water from adjacent slope bypasses underdrain and saturates subbase.
2. Lack of support from subbase weakened by saturation resulted in cracked pavement.

Case B. Rt. 15 West Bound Sunset Hill E. Htfd.

1. Same cross section as east bound lanes.
2. Pavement is in good condition.
3. External water does not enter subbase.
4. No evidence of frost heaving in winter.

Case C. Rt. 15 East Hartford

Between Sunset Hill and E. Htfd. Interchange - Low fill with the same pavement and foundation dimensions as Cases A and B; no underdrains.

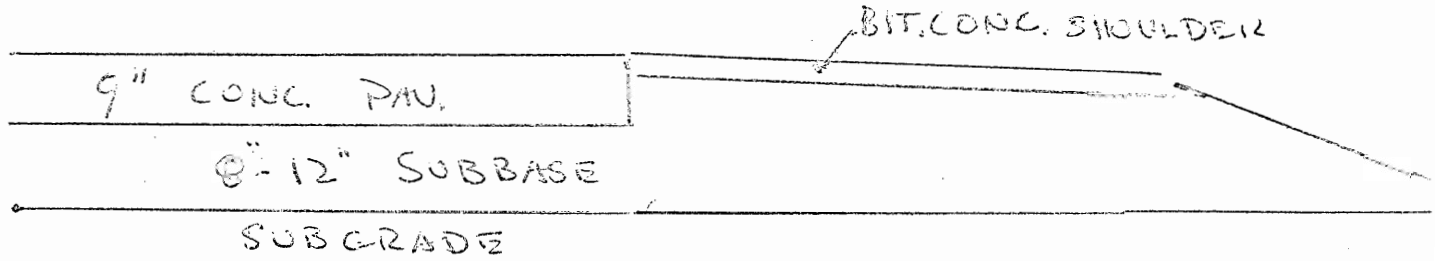
Subbase - Non-frost susceptible gravel

Subgrade - Fine to medium sand, non-frost susceptible (based on field classification)

Observations

1. Pavement is in excellent condition, no frost heave in winter, no pumping in spring.
2. Water table is at or near the surface of surrounding area. Pavement 2-3 feet above water table.
3. One of the few areas along this highway where the joints have not shifted.

Case D. Rt. 15 Tolland (near exit 99, Rt. 195)



Pavement - Generally good condition, but some slabs are extensively cracked.

Subbase - Non-frost susceptible 6% < 200 sieve, $K = 2 \times 10^{-4}$ ft/in

Subgrade - Moderately frost susceptible $K = 1 \times 10^{-5}$ ft/min, 15% < 200 sieve

No Underdrains

Observations

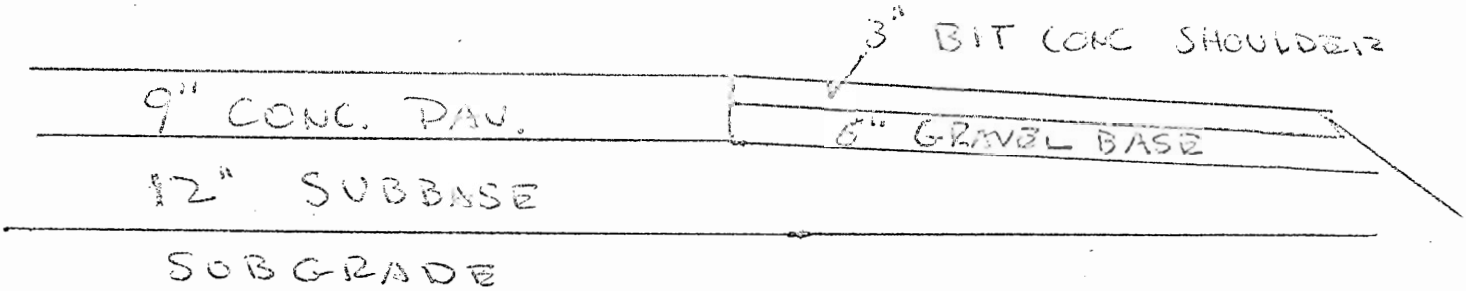
1. Substantial joint shifting during winter (lateral and longitudinal)
2. Pavement breakage where subbase is less than 10" thick
3. Water table is generally low in the area. No signs of pumping; some water issuing from joints after rain.

Apparent Cause of Problem

1. Frost heave in subgrade, with subbase too thin to prevent damage to pavement, and shifting of slabs.

Case E. Rt. 91 Wallingford

Rt. 2 Colchester



Gravel Base - frost susceptible

Subbase - non-frost susceptible

Observations

1. Shoulder heaves locally 2" - 3" above concrete pavement.
2. Water table is well down in area.

Apparent Cause of Problem

Frost susceptible soil directly under shoulder.

CONCLUSIONS

1. If subbase and subgrade are non-frost susceptible, high water table (2 - 3' below pavement) is not detrimental (Rt. 15, E. Htfd.).
2. If subbase is frost susceptible, there will be frost damage independent of ground water condition (Rt. 2, Colchester, I-91).
3. If subgrade is frost susceptible and subbase is less than 12" thick, under concrete pavement there will be frost damage independent of ground water condition (Rt. 15, Tolland).
4. If subbase is saturated by ground water, damage to pavement will result irrespective of quality of subbase. (Rt. 15, Sunset Hill)
5. Requirements of subbase:
   a) Non-frost susceptible (< 3% finer than 0.02 m.m.)
   b) Protected from ground water
   c) Sufficiently thick (12") to protect frost susceptible subgrades